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ABSTRACT

The Virtual Workshop is a World Wide Web-based set of modules on high performance computing developed at the Cornell Theory Center (CTC) (New York). This approach reaches a large audience, leverages staff effort, and poses challenges for developing interesting presentation techniques. This paper describes the following techniques with their technical implementation, application in the workshop, and assessment by the audience and staff: (1) Web-based editing and program submission using a combination of Java programs and Perl scripts; (2) the glossary, created with JavaScript; (3) using Common Gateway Interface (CGI) scripts to write interactive quizzes; (4) Netscape frames for personalizing navigation; (5) gifmerge for creating simple animations and a QuickTime movie to demonstrate and compare speedup achieved through Message Passing Interface (MPI) and High Performance Fortran (HPF); (6) a lab exercise design using HTML links; (7) a set of audio-tagged foils to diversify and increase comprehension of the module; and (8) MOO/chat discussion forums. Three figures illustrate the Web-based editing/program submission screen, the glossary, and a graph of the Quick Time movie. Related Web sites are listed. (Author/AEF)

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ED 429 528

Techniques For Enhancing Web-Based Education

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Abstract: The Virtual Workshop is a Web-based set of modules on high performance computing. This approach reaches a large audience, leverages staff effort, and poses challenges for developing interesting presentation techniques. This paper describes the evaluation of seven techniques from the point of view of the participants and the staff developers.

Introduction

Asynchronous learning over the Web is an exciting and rapidly changing area. Cornell Theory Center (CTC) entered this arena in 1995 with its first offering of the Virtual Workshop (VW). Since then, we have expanded the scope of topics and introduced new Web-based features to enhance the learning environment. Seven techniques are presented with their technical implementation, application in the workshop, and assessment by the audience and staff.

CTC Education and the Virtual Workshop

Over the past ten years, CTC has been a leader in developing and delivering education in high performance computing to a national base of researchers, faculty and students. CTC education programs include on-site workshops, undergraduate programs, education accounts for college courses, and programs geared to K-12.

By 1995, the tools were available to pursue offering a remote workshop via the World Wide Web. Web-based materials are well suited to our education environment, which requires frequent material updates to keep pace with rapidly changing technology. We transformed our extensive set of workshop lectures, on-line tutorials, and lab exercises into Web-based modules. We began by offering a beta-test Virtual Workshop in the spring of 1995. Response to this initial test was so enthusiastic we were encouraged to further develop this format. Since then, we have offered five production Virtual Workshops to about 800 participants. These workshops covered six topics comprised of over thirty modules; Parallel Programming, Message Passing Interface (MPI), High Performance Fortran (HPF), Parallel Virtual Machine (PVM), Performance, and Scientific Visualization.

A common theme in the VW evolution is experimentation with techniques intended to provide more interaction and options for participants with different learning styles. Most of the features discussed below were designed for, or used by, an HPF module created in 1996 by the authors and others.

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Technical Features and Their Applications

We designed the HPF module specifically to be offered over the WWW. This prompted us to explore methods and techniques which replace some of the interactive nature of a face to face workshop. This module builds on successful features from previous VWs and adds some new ones described below.

Java and Perl Scripts - Web-based Editing and Program Submission

A more comprehensive total learning environment has been achieved by adding the ability to edit, compile, set run-time parameters such as number of processors, and submit a program, all without leaving the Web browser. Results of the compile and program execution are displayed in a Java program window. This automatic Web-based program submission interface, called the VW Companion, utilizes a combination of Java programs and Perl scripts. The Java programs handle the front end user interface, while the Perl scripts interact with AFS Kerberos authentication to provide the required security for the users.

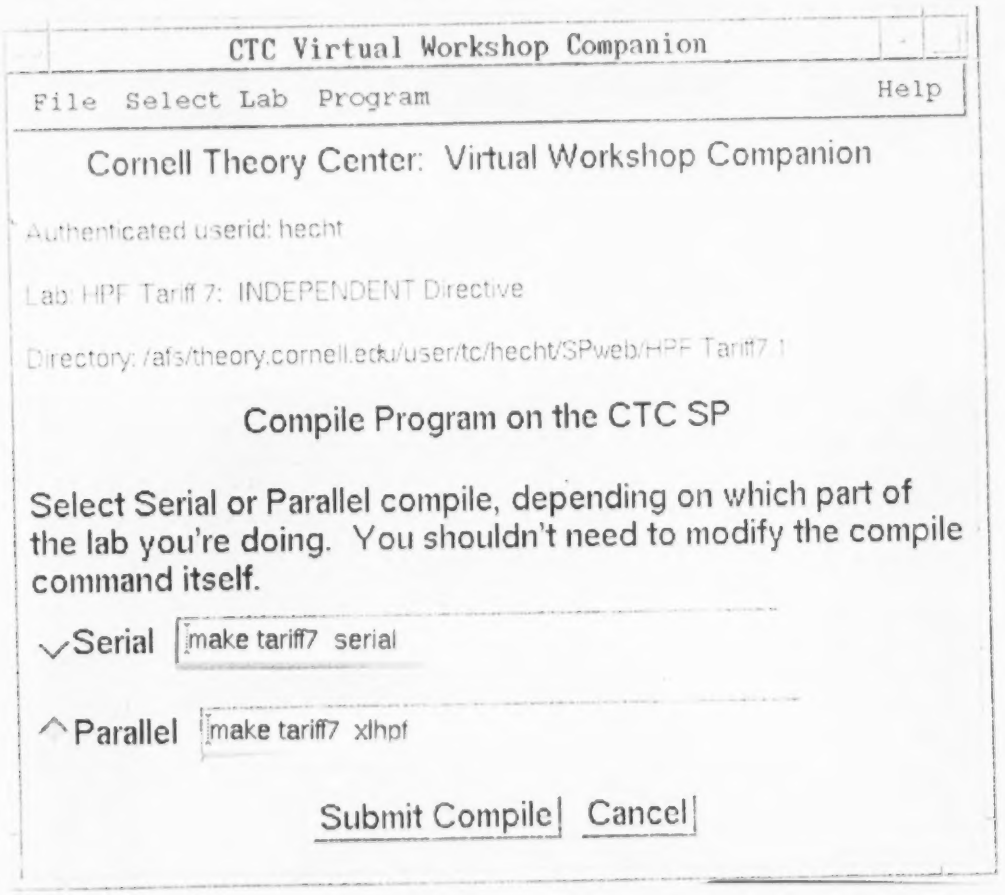
CTC Virtual Workshop Companion
File Select Lab Program Help
Cornell Theory Center: Virtual Workshop Companion
Authenticated userid: hecht
Lab: HPF Tariff 7: INDEPENDENT Directive
Directory: /afs/theory.cornell.edu/user/tc/hecht/SPweb/HPF Tariff7 1
Compile Program on the CTC SP
Select Serial or Parallel compile, depending on which part of the lab you're doing. You shouldn't need to modify the compile command itself.
Serial
make tariff7 serial
Parallel
make tariff7 xlhpf
Submit Compile
Cancel

Figure 1: Web-based Editing and Program Submission

JavaScript - Glossary

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JavaScript was used to create a self-referencing glossary. Glossary terms in the text of the module are in italicized, bold font. Clicking on a term causes the glossary to appear in a smaller window, with that term and the definition at the top of that window. Definitions in the glossary also contain other linked terms. Implementation of the JavaScript was fairly easy. The difficult aspect is achieving similar appearance and functionality across browsers and platforms. The glossary concept is well received and seems to be 'expected' by the participants. Once the initial glossary was in place, it was fairly easy to add terms to it and use it across all our education materials.

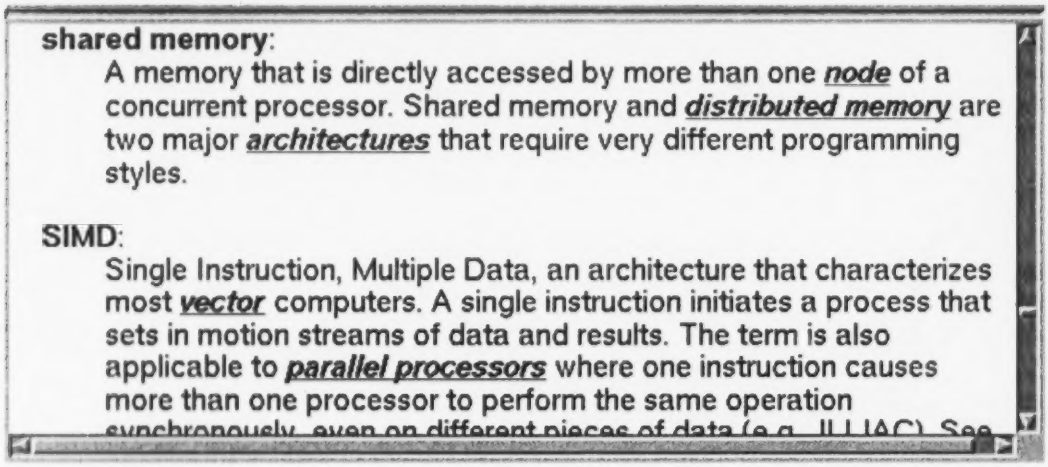
shared memory:
A memory that is directly accessed by more than one node of a concurrent processor. Shared memory and distributed memory are two major architectures that require very different programming styles.
SIMD:
Single Instruction, Multiple Data, an architecture that characterizes most vector computers. A single instruction initiates a process that sets in motion streams of data and results. The term is also applicable to parallel processors where one instruction causes more than one processor to perform the same operation

Figure 2: Glossary

CGI Scripts - Interactive Quizzes

We have used CGI scripts to write interactive quizzes for our training materials. The quizzes are written as forms in a multiple choice format. Filling out and submitting the quiz form automatically grades the quiz and returns a list of questions that were answered incorrectly. An option button allows the participant to choose whether they wish to receive a detailed explanation of all quiz answers along with the grading results. Quizzes consist of a CGI script, which handles the grading, a form which contains the questions, and an ascii file listing the correct answers. The CGI script was written to handle any multiple choice quiz. Developers find it very easy to create quizzes, since only a form with questions and an ascii file of correct answers must be written. Workshop participants like the simple format and immediate answers, as well as being able to test their understanding.

Netscape Frames - Personalizing Navigation

Use of frames allows workshop participants to move through material in a way that best suits their learning style and needs. The HPF module was designed around an HPF program; workshop participants can learn the material either by working through the program or by working through the topics as displayed in the Table of Contents in the left-most frame. Frames allow coordination of material shown in two frames, by use of a simple link. In the HPF module, the reader can read about a program directive in one frame, and with the targeted link, move the program shown in another window to display the directive as used in the program. This method of organizing materials is easily adopted by staff.

Gifmerge and QuickTime - Animations

We have used gifmerge to create small, simple animations, such as this animation of an array shift. Gifmerge is popular with developers, because it is freely available via the Web and very simple to use. Gifmerge can take gifs created by any means and merge them into an animation. VW participants found that these animations enhanced the text description of the topic. Gifmerge is easily used because it doesn't require disk space or special hardware or software.

A QuickTime movie was created to demonstrate and compare speedup achieved through MPI and HPF. The technique demonstrates a successful approach of teaming the content expert with an animation specialist and creating a high quality movie which adds to the understanding of the results. It allows the author to zoom sections of the graph and emphasize the critical portions in conjunction with the narration. The movie, which runs on PCs, Macs, and UNIX platforms, was divided into three parts ranging in size from 2 Mbytes to 6 Mbytes. Based on review from our academic affiliates, we learned that downloading files this size over the internet was too time consuming and few waited for the results. As an alternative to the movie, we provided the same information in a series of graphs and corresponding text, taken from the narration. This proved to be an effective approach for the participants and required significantly less staff time and effort. As compression techniques and internet bandwidth improve, QuickTime movies will become more viable.

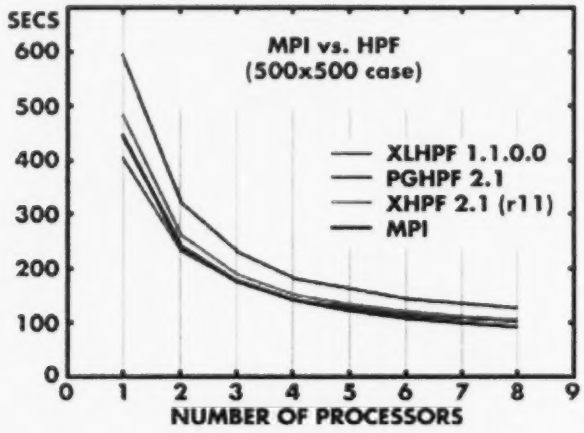

Figure 3: QuickTime Movie

HTML Link Usage - Lab Exercise Design

It is difficult to design lab exercises which target a broad audience with varying levels of knowledge on the topic. In addition, VW participants want lab exercises to be simple, yet meaningful. We have attempted to provide this by writing a lab exercise which is broken into small steps. Each incremental step is presented with a standard set of helpful links, including detailed instructions, common errors, and the solution for each step. This approach allows individuals to choose the amount of guidance they receive at each stage. A recent participant notes "The lab was quite good, since it took things in small steps which is essential to feel comfortable with parallelizing (the program) without getting overwhelmed."

Audio - Hearing From the Experts

In an effort to diversify and increase comprehension of the module, we introduced a set of audio-tagged foils. We videotaped a lecture at CTC, transferred the digitized audio to a file, edited and converted it to aiff (Mac) format and .au files. These files were then 'tagged' to the foil used in the presentation and inserted in the module. The participants were able to click on a sound icon and hear portions of the lecture in addition to reading the foil. Early feedback indicated a preference for text rather than wait to download even small file (.3 Mbytes). The staff effort involved here did not warrant pursuing this approach. Streaming audio offers a more promising approach to enhancing text.

MOO/Chat - Discussion Forums

The first two VWs offered a MOO as a forum to promote discussion among the participants as well as with the CTC staff. We offered 'rooms' in the MOO devoted to individual topics as well as scheduled times for staff to be in attendance. Few of the participants took advantage of the MOO. It required the audience to use a new tool and the scheduled times were contrary to the asynchronous nature of the VW. We then pursued a Web-based chat room which was more intuitive to use. Again we met with limited success. These approaches were not a good match for the format of this workshop. We would like to pursue more collaborative forums in the future.

Conclusions and Futures

Web-based education is an effective means for CTC to leverage its education efforts in reaching a diverse national audience. Based on evaluations from the participants, this asynchronous approach to learning affords them the opportunity to learn high performance computing without the inconvenience or expense of traveling to CTC. Convenient Web-based editing and submission of programs is in line with the look and feel of the materials. Self-assessment through interactive quizzes using CGI scripts are very well received. We have successfully used new techniques such as Java and JavaScript to enhance the interactive nature of the workshop. Network bandwidth restrictions reduce the effectiveness of some audio and video features.

Summary of URLs

Cornell Theory Center
http://www.tc.cornell.edu/

CTC education programs
http://www.tc.cornell.edu/Edu/

CTC on-site workshops
http://www.tc.cornell.edu/Edu/Workshops/

CTC undergraduate programs
http://www.tc.cornell.edu/Edu/SPUR/

CTC education accounts
http://www.tc.cornell.edu/Edu/CTC/

CTC programs geared to K-12
http://www.tc.cornell.edu/Edu/CTC/EduK-12.html

Example of an HPF module:
http://www.tc.cornell.edu/Edu/Talks/HPF/Intro/

VW Companion top page:
http://arms.tc.cornell.edu/VWCompanion/

Example of an interactive quiz:
http://www.tc.cornell.edu/Edu/Talks/HPF/Intro/distribute.html#Quiz

Example of an animation using gifmerge:
http://www.tc.cornell.edu/Edu/Talks/HPF/Intro/cshift1.html#General

Gifmerge home page:
http://err.ethz.ch/~kiwi/GIFMerge/

HPF exercise:
http://www/Edu/Tutor/HPF/Essentials/Karp/

References

[Mehringer and Barbieri, 1996]. Mehringer, S.H., & Barbieri, K.A. (1996). A Workshop at Your Workstation *Forefronts* 11 (4), Fall 1996, 10-11.

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Author Biographies

Kathy Barbieri is currently Coordinator for Training and Integration for Cornell's Project 2000. Previously, during her ten years at CTC, she was Coordinator for Distributed Education, involved in conceiving the concept of the VW as well as developing some of the materials and interactive techniques. She also worked with CTC partners to bring the VW to other locations.

Susan Mehringer is a Senior Technical Consultant at the Cornell Theory Center, where she has been since 1987. Her current projects include work on the Virtual Workshop project, including developing modules, consulting, and assessing WWW statistics; testing new systems and software; consulting; and developing and delivering training materials.

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